

REMARKS

Claims 1-9, and 20 are now in the case for examination. Claims 10-17 are withdrawn and will be cancelled upon the allowance of claims.

Support for amended claims is found on paragraphs 41, 42 and 43 on page 9.

The rejection of claim 18-20, under 35 U.S.C. § 112, first paragraph, because the specification does not provide enablement for oxidizing of CO₂ has been overcome by the cancellation of claims 18 and 19. The Applicants are unclear regarding the rejection of claim 20, as claim 20 is dependant on claim 3 and is not directed to the oxidation of CO₂. The Applicants believe claim 20 is a proper claim; however, if the Examiner maintains her rejection the Applicants will reconsider the rejection.

The rejection of claim 1-9, and 18, under 35 U.S.C. § 103(a) for being unpatentable over Izutsu et al., U.S. Patent No. 6,355,084 in view of Hammer et al., U.S. Patent No. 6,759,022 and the prior art on page 4, paragraph 13 have been overcome by amendment to the claims.

The Applicants' invention is directed to a simplified process for the removal of carbon dioxide, and the simultaneous removal of oxidized acid anhydride precursor gases and acid moieties, specifically SO₂, NO_x, HCl and HF. The Applicants' process provides for the cooling of flue gases containing CO₂, acid anhydride precursors, and acid moieties, removing particulate, oxidizing the precursors and simultaneously converting the oxidized acid anhydrides precursors and other acid moieties to ammonia salts and then converting carbon dioxide to an ammonia salt. Applicants' invention is not directed to removal of selected acid anhydride precursors. The prior art suggests the removal of selected components, not the simultaneous conversion and collection of acid anhydride precursors and acid moieties. The references cited

by the Examiner do not suggest the removal of CO₂ from flue gases with the use of aqua ammonia compounds.

Izutsu et al., U.S. Patent 6,355,084, is directed to the production of a fertilizer by injecting ammonia into and applying an electron beam to a gas containing sulfur oxides. Izutsu does not teach the simultaneous conversion of oxidized acid anhydrides precursors and acid moieties, which includes HCl, HF and to ammonia salts and the subsequent conversion of carbon dioxide to an ammonia salt. Further, Izutsu does not suggest the use of aqua ammonia in the removal process. The Applicants argue that the invention as now claimed is novel and unobvious over Izutsu, U.S. Patent No. 6,355,084.

Hammer et al., U.S. Patent 6,759,022, is directed to the sequential removal of acid gases and NO_x from flue gases. The acid gases absorbed by sequential scrubbing with a scrubbing medium. NO_x gases are then oxidized. The resulting mix is reacted with ammonium hydroxide to form ammonium nitrate. Hammer does not teach the simultaneous conversion of acid anhydride precursors, including SO₂, NO_x, and acid moieties, including HCl and HF, to ammonium salts, and the subsequent conversion of carbon dioxide to an ammonia salt. Hammer do not suggest or disclose the regenerability of the ammonia-containing compounds, as covered by claims 3 and 20 of the Applicants' application. The Applicants argue that the invention as now claimed is novel and unobvious over Hammer, U.S. Patent No. 6,759,022. As the two references cited by the Examiner disclose the selective removal of some flue gas contaminants, the Applicants argue that the combination of these references does not suggest the simultaneous removal of oxidized acid anhydride precursors and acid moieties as claimed in

the instant application. Applicants further argue that the invention of claims 1-9, and 20 is novel and unobvious over Izutsu in view of Hammer.

While the oxidation of sulfur dioxide is suggested in paragraph 13 on page 4 of the application, the other elements of the Applicants' invention are not suggested or disclosed in Izutsu and Hammer. Therefore, claims 1-9, and 20 are clearly novel, unobvious and patentable over the cited references.

In like manner to the limitations of claim 1, wherein gaseous anhydrides are oxidized to higher gaseous acid anhydrides of claim 2; further wherein the step of converting includes reacting the oxidized anhydrides with ammonia-containing compounds in claim 3; further wherein the ammonia-containing compounds are water-soluble compounds selected from the group consisting of aqueous ammonia, ammonium hydroxide, ammonium carbonate, ammonium carbamate, and combinations thereof in claim 4; wherein the ammonia-containing compounds are regenerated by the thermal decomposition of ammonium bicarbonate (NH_4HCO_3) to carbon dioxide (CO_2), ammonia solution (NH_4OH), ammonium carbonate ($(\text{NH}_4)_2\text{CO}_3$), and combinations thereof of claim 5; wherein the process is carried out at temperatures of from about 15°C to 50°C in claim 6; wherein the regeneration is carried out at a temperature from about 35°C to 80°C of claim 7; wherein ammonia generated from the decomposition of ammonium bicarbonate is recycled for use in the converting step of claim 8 and wherein the other acid moieties are hydrogen halides of claim 9 are not obvious over Izutsu in view of Hammer.

The rejection of claim 1-9, and 18-20, under 35 U.S.C. § 103(a) for being unpatentable over Mimura et al., U.S. Patent No. 5,648,053 in view of Izutsu '084 and Gal U.S. Patent No.

5,624,649 and optionally, further in view of Slavid et al U.S. Publication No. 2002/0058164 have been overcome by amendment to the claims.

The Applicants' invention is discussed hereinabove.

Mimura et al., is directed to a process for removing both CO₂ and NO_x by bringing the gases into contact with an aqueous solution of an alcoholic hydroxyl-containing secondary or tertiary-amine solution. Mimura do not teach the simultaneous conversion of oxidized acid anhydrides precursors and acid moieties, which includes HCl, HF and to ammonia salts and the subsequent conversion of carbon dioxide to an ammonia salt. Further, Mimura do not suggest the use of aqua ammonia in the removal process. The Applicants argue that the invention as now claimed is novel and unobvious over Mimura, U.S. Patent No. 5,648,053.

The discussion of Izutsu appears hereinabove. As Izutsu removal process utilizes ammonia, while Mimura's process utilizes an aqueous solution of an alcoholic hydroxyl-containing secondary or tertiary-amine solution, the Applicants can find no basis for combining these references. Further, even if these references were combined, they would not result in the Applicants' invention, a process providing for the cooling of flue gases containing CO₂, acid anhydride precursors, and acid moieties, removing particulate, oxidizing the precursors and simultaneously converting the oxidized acid anhydrides precursors and other acid moieties to ammonia salts and then converting carbon dioxide to an ammonia salt. As neither reference, alone or in combination, suggests or discloses the unique set of gaseous impurities removed or Applicants' unique reactant, the Applicants argue that the invention as now claimed is novel and unobvious over the combination of Mimura and Izutsu.

Gal is directed to the removal of sulfur dioxide from flue gases by reacting an ammonia-based solution with the flue gas. Gal discloses that ammonia chloride and ammonium fluoride may be produced from gases containing hydrogen chloride and/or hydrogen fluoride. Gal does not suggest the removal of SO₂ or NO_x from the gas stream with his process. As Gal does not suggest or disclose the unique set of gaseous impurities removed or Applicants' unique reactant, the Applicants argue that the invention as now claimed is novel and unobvious over Gal.

Slavid et al. U.S. Publication No 2002/0058164 is directed to the protection of calcareous building material by the application of an aqueous solution of hydroxycarboxylic acid. Slavid discloses in paragraph 0003 that sulphur dioxide is oxidized by ozone and nitrogen oxides. As Slavid do not disclose or suggest the elements of the Applicants' invention, the Applicants argue that their invention is novel and unobvious over Slavid.

The Applicants argue that the invention as now claimed is novel and unobvious over the combination of Mimura in view of Izutsu and Gal and optionally further in view of Slavid.

CONCLUSION

The Applicants believe that the application, including claims 1-9, and 20, is now in allowable form. Allowance is therefore respectfully requested.

Respectfully submitted,

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